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Bulletin of the Michigan Fish Commission

No 2

BIOLOGICAL STATION
UNIVERSITY OF MICH
TOPINABEE, MICH.

THE PLANTS OF LAKE ST CLAIR

GREAT LAKES RESEARCH

By A J Pieters

With a Map

Results of a Biological Examination of Lake St Clair undertaken for the State Board of Fish Commissioners in the Summer of 1893 under the Supervision of J E Reighard

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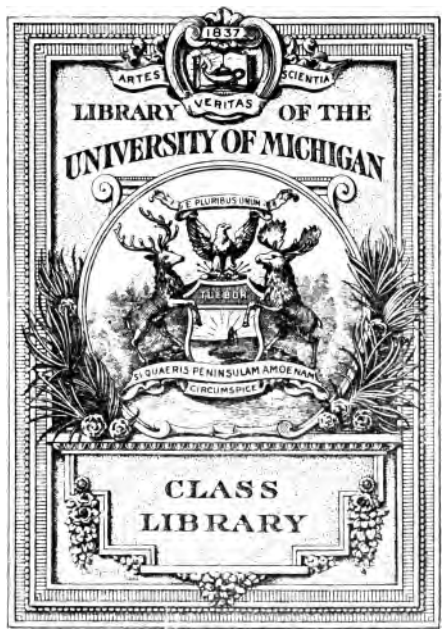
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No 2

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Great Lakes
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THE PLANTS OF LAKE ST. CLAIR.

During the summer of 1893 the Michigan Fish Commission sent a party under the direction of Professor J. E. Reighard to study the flora and fauna of Lake St. Clair and to make other observations of value to the Commission. The writer accompanied the party as botanist and the following notes are the result of observations made at that time.

A laboratory was fitted up at New Baltimore, on Anchor Bay, and most of the work was done in the bay and the neighboring marshes. Towards the close of the summer various localities in the western part of the lake were studied and one trip was taken past the head of the ship canal into Canadian waters and thence up the south channel of the St. Clair River as far as Algonac. The time spent on the work was from the middle of July to the middle of September. The first four weeks were occupied in studying the microscopic forms found free in the bay. The material was obtained from the "tows" that were brought in, at first every morning, and later two and three times a week. The "tows" were taken in the following manner: Two nets, made of fine cloth, and provided at the bottom with screw caps similar to those used on oil cans, were drawn through the water by a sailboat at the rate of 4–10 kilometers an hour according to the strength of the wind. One net was attached to an iron frame and allowed to sink so that it was drawn along at about two inches from the bottom; the mouth of the other net was always kept partly out of the water so as to take in only surface forms. After sailing fifteen minutes the nets were taken in and, by throwing water against the outside of the nets, the contents were washed down into the caps at the bottom. The material thus collected was emptied into jars. In drawing up the bottom net a few surface forms were necessarily taken in with the others, but a comparison of many tows showed that these could have had no appreciable influence on the result, since the forms found at the surface and near the bottom were practically the same. For the study of the bottom of the lake, a drag made in the following manner was used: Pieces of heavy steel wire 15 inches long were bent in the middle and then thrust through a piece of one inch lead pipe about six inches in length. The ends of the wires were then bent back to form a circle of hooks each one about 2½ inches long while a number of loops, made by the bending of the wires, was left at the other end of the pipe. A rope was tied through these loops and the drag was ready for use. This was thrown out every two or three hundred feet; a good knowledge of the bottom was thus obtained for that part of the lake examined.

To the writer's knowledge the only work done in this country bearing upon the subject of the distribution of plants in lakes and rivers is that by Professor Douglas Campbell ('86) on the plants of the Detroit River, an unpublished report by Mr. W. H. Rush to the Michigan Fish Commission, for 1891, and a paper on the occurrence of sphagnum atolls in central Minnesota by Professor Conway McMillan ('93).

In Europe some attention has been paid to the study of fresh water plant and animal forms and interesting observations have been recorded by different workers. A. Magnin ('93) studied the distribution of plants in the lakes of the Jura. The orignal paper was not accessible, and the results given below were obtained from a review in Natural Science.[1] In the deep lakes Magnin found several well marked zones of plant life. Passing from the shore to the center, these zones are: *First*, a littoral zone, which he divides into Phragmitetum and Scirpetum, the former extending to a depth of 2–2½ meters, while the latter forms a second zone to the depth of 3 meters. The plants characteristic of this zone are: Phragmites communis, Scirpus lacustris, sedges, Equisetum limosum, Polygonum amphibium, Phellandrium, Nymphaea alba and Potamogeton natans. *Second*, beyond the bulrushes is the Nupharetum. Plants with large floating leaves as Nuphar luteum, are characteristic of this zone which extends to a depth of 3–5, usually 4 meters. *Third*, "the third zone, or Potamogetonetum, is formed by plants different according to the lake; sometimes pondweeds, chiefly Potamogeton perfoliatus, then P. lucens or P. crispus; less often Myriophyllum spicatum, or still more rarely the marestail (Hippurus vulgaris), all bearing their leafy or flowering stems at or near the surface on stems 4–6 meters long." *Fourth*, in the deepest water, 8–10 and 12 meters deep, the bottom is covered with Characeae, Naias major, and the mosses, Fontinalis antipyretica and Hypnum giganteum. This zone he calls the Characetum. "In deep lakes with rocky borders, plant life is absent or represented only at points where erosion or a falling [of the bank?] has occurred, by tufts of reeds or bulrushes, associated or isolated, and sometimes followed inside by the yellow water lily and Potamogeton perfoliatus. The turf lakes, with abrupt, sharply sloping margins, differ in having a very narrow littoral zone, * * *." Shallower lakes show a mixed vegetation.

Lake St. Clair is little more than an expansion of the St. Clair River. It is shallow throughout, not reaching, except in the channels, a depth greater than 7 meters, and averaging far below this. In Anchor Bay, where most of the work was done, the depth ranges from 2½ to 4½ meters, with a wide zone of more shallow water near the shore. At the head of the lake are the famous St. Clair Flats, great stretches of marsh formed by the deposit from the St. Clair River. Through this deposit the river finds its way by several channels, from some of which a strong current is perceptible some distance into the lake. The shore of the lake is bordered by many swamps, especially at New Baltimore and about the mouths of Salt Creek and Clinton River. (See accompanying map for these places.) At other points the shore is abrupt and without any low ground. The gradual slope of the bottom, especially from the swamps near New Baltimore, offers the best conditions for the study of the influence of depth on the distribution of plant forms. Besides the condition of depth, the flora is, in some respects, also influenced by the character of

1 Natural Science, vol. 3; No. 20, 248; Oct., 1893.

the bottom, according as it is clay, sand or an alluvial deposit. This is particularly the case with Characeae, which were seldom found on sandy bottom.

The influence of these two conditions, more especially that of depth, has caused the distribution of the plants into more or less well marked zones, while at the same time the shallowness of the water and the gradual slope have given rise to a somewhat mixed flora. The boundaries between zones are not sharply marked; there is a mixture of forms on the edges of each zone and, in the case of the Potamogetonetum and the Characetum, an overlapping of the latter zone over the entire extent of the former. The strength of the currents in Lake St. Clair gives rise to a third condition, that of rapidly flowing water, which doubtless exerts a marked influence on the flora. It is to be regretted that the observations on this point are not sufficiently detailed to warrant general conclusions. Two other conditions, which may be considered independently, but which are really related to that of depth, are the mechanical action of the waves and currents and the amount of light. How plants accommodate themselves to these two conditions will be mentioned below.

Coming now to the consideration of the zones in order, it may be stated that for some distance west of New Baltimore the lake is bordered by a swamp which slopes gradually into the water. This low ground offers the best conditions for the study of the Phragmitetum. Owing to shallow inlets which everywhere indent the border of the swamp, the line between the Phragmitetum and the next deeper zone, the Scirpetum, is an irregular one. The plants of the former occupy the low ground and the very shallow water, which seldom exceeds 20–40 cm. in depth. The growth in this zone is luxuriant; the conspicuous plants are large and leafy, often attaining a height of 2 meters, while a thick growth of smaller forms occupies the wet ground at their bases. The following plants are characteristic of this zone: Phragmites communis Trin, Typha latifolia L., Acorus calamus L., Scirpus atrovirens Muhl., S. fluviatilis Gray; common. Zizania aquatica L.; common in water 30–40 cm. deep and in the more watery parts of the swamp. Sagittaria heterophylla Pursh, var. rigida Engelm.; in great patches in shallow water. S. variabils Engelm.; with the former species, but not so abundant. Sparganium eurycarpum Engelm.; common everywhere in shallow water. S. simplex Huds.; occasionally found with S. eurycarpum. Polygonum muhlenbergii Watson; abundant along both banks of Salt Creek for some distance above its mouth. Decodon verticillatus Ell.; abundant along Salt Creek. Pontederia cordata L.; common everywhere in shallow water. This was found, in one case, near the mouth of Salt Creek, growing among Scirpus pungens in 60 cm. of water and about 800 meters from the shore. Cyperus filiculmis Vahl, C. engelmanni Steud., C. diandrus Torr., var. castaneus Torr.; abundant in wet but not submerged places. Carex filiformis L., C. filiformis L., var. latifolia Boeckl.; abundant at the flats and common near New Baltimore. C. vulpinoidea Michx., Eleocharis ovata R. Br., E., palustris R. Br., E. acicularis R. Br., common. E. palustris R. Br. var. glaucescens Gray, Juncus nodosus L., common. J. canadensis J. Gay, var. longicaudatus Engelm., Alopecurus geniculatus L., var. aristulatus Torr., Nymphaea reniformis D. C., Nuphar advena Ait.; common in the shallow water at the flats, near New Baltimore and in Salt Creek. Elodea canadensis Michx.; common in the swamp pools and near the dock at New

Baltimore. Lemna trisulca L., Spirodela polyrhiza Schleid., Utricularia vulgaris L., abundant in quiet water.

In the shallow inlets above mentioned the flora is mixed. There is a thin growth of Scirpus pungens with a few plants of Sagittaria and of Sparganium while Potamogeton lonchites Luck, with the variety noveboracencis Morong, and P. heterophyllus Schreb., also occur in these inlets.

Two species are characteristic of the Scirpetum, Scirpus pungens Vahl, and S. lacustris L. Of these S. pungens grows in the shallow water ½–1 meter in depth, while S. lacustris grows in water 1–2 meters deep. Although fairly well marked this zone suffers from the encroachments of species from both sides. Of the Phragmitetum, Sagittaria heterophylla, var. rigida and Pontederia cordata are often found with Scirpus pungens, and species of Potamogeton usually growing in deeper water encroach upon S. lacustris. Outside of the Scirpetum, towards the deeper water both the Potamogetonetum and the Characetum begin, the former occupying a zone of water 2–4 meters deep while the latter covers the bottom throughout the western part of the lake. Magnin's Nupharetum does not exist. Our species of Nuphar, N. advena, grows in shallower water and belongs to the Phragmitetum where also belong all our plants with large floating leaves. Potamogeton natans and P. perfoliatus which Magnin sometimes found in the Nupharetum belong to our Potamogetonetum and are only occasionally found in the Scirpetum.

The plants of the Potamogetonetum are either wholly submersed or have only the upper leaves floating and the flowers elevated above the water. The species found in this zone are: Potamogeton natans L.; common in water 2-3 meters deep. P. fluitans Roth; also found with Scirpus lacustris on the edge of the Scirpetum. P. zizii M. & K.; common and variable. P. heterophyllus Schreb.; in the shallow parts of the Potamogetonetum and encroaching upon Scirpus lacustris. P. heterophyllus Schreb., var. longipedunculatus Morong; with the species. P. perfoliatus L.; the most abundant species in the lake. This is the prevailing species on the bars throughout the lake; sometimes apparently the only one. Ceratophyllum demersum L.; common. Valisneria spiralis L.; abundant near New Baltimore and found to some extent at nearly every station.

The plants of the Characetum cover the bottom from the line of the zone of rushes throughout the American part of the lake at a depth of 2–7 meters. The distribution of the Characeae is affected both by depth and by the character of the bottom. Wherever the bottom is clay or alluvial deposit the Charas abound; where it is sandy or where a thick layer of sand covers the clay, they are scarce or entirely absent. During our one trip into Canadian waters a few isolated tufts of Chara contraria A. Br. were found but generally the bottom was sandy and no Characeae were seen. Chara contraria A. Br., is the prevailing species of this family in Anchor Bay. In the deeper parts of the bay it is mixed with Tolypella intertexta Allen, which grows more abundant in the lake and finally displaces Chara contraria. Chara intermedia A. Br. (probably); This was found at the stations numberd XI, XIII, XIV, on the map. Nitella tenuissima Desv., var. incrustata; at stations IV, V, VI, VII, XVI. Chara sp. either a new species or an anomolous form of Chara coronata; not abundant but was found at stations III, V, VI, VII, VIII, IX, XV and XVI. Naias flexilis L.; abundant everywhere.

Throughout the lake species of Potamogeton occur among the Characeae but they are not abundant in water over four meters deep.

The study of the Algæ was mainly confined to the microscopic forms found in Anchor Bay. A few species were collected from other localities and some were identified later from material collected from Utricularia. Most of the microscopic forms found in the bay are mechanically suspended but a few, as Pandorina morum Bory, and perhaps some of the Diatoms are free swimming. It is doubtless owing to the shallow water that the minute forms of plant life are nearly the same at the surface and near the bottom. The individuals of a species are somewhat more numerous at the surface but the number of species does not materially vary.

With the exception of the Desmids, which were found only at the surface, nearly all the species were found in both surface and deep tow. The presence of the Desmids is perhaps accidental, they having probably been washed from Utricularia or out of some of the shallow pools near the shore. The following is a list of Algæ both free and attached that were found in Anchor Bay, at the stations in the lake and in the swamps near New Baltimore.

Spirogyra nitida [1] (Dilln.) Link; common in the marsh pools. Spirogyra sp.; a small species found in considerable abundance near New Baltimore but not in fruit. Vaucheria geminata (Vauch), D. C.; common in wet places. V. tuberosa A. Br.; this differs from the type. It was found only at Stations III and V in water 5–6 meters deep. Cladophora sp.; a coarse form growing thickly among Chara near New Baltimore and at station VII. Pithophora sp.; abundant in Salt Creek. Mesocarpus sp.; in the marsh pools. Tolypotrix lanata Wartman, in and near the mouth of Salt Creek and once near the dock at New Baltimore. Tolypotrix sp.; mixed with Pithophora in Salt Creek. Chaetophora cornu-damae (Roth) Ag. var. genuina; occasionally on sticks and mussel shells near the shore. Coleochaete scutata Breb.; on rush culms. Bulbochaete sp.; on rush culms. Gleotrichia pisum Thur.; common on water plants. Protococcus viridis Ag.; in surface and in deep tow. Merismopedia convoluta Breb., Pandorina morum (Muell?) Bory, Pediastrum boryanum (Turpin) Menegh., Sphaerozyga polysperma Kg.; in surface tow and deep tow, most frequent in surface tow. Clathrocystis aeruginosa Henr.; surface and deep tow, most often in surface tow and sometimes very abundant. Gomphosphaeria aponia Kg.; not abundant but found in both surface and deep tow.

DIATOMACEAE.

Gomphonema geminatum (Lyng.) Ag.; deep tow. Asterionella formosa Hass.; surface and deep tow, most frequent in surface tow. Tabellaria fenestra (Lyng.) Kuetz., T. flocculosa (Roth) Kuetz.; common in surface and deep tow. Nitzschia sigmoidea (Nitzsch.) Wm. Sm.; surface and deep tow. Synedra affinis Kuetz., var. tabulata (Ag.) V. H., Cystopleura gibba (Ehr.) Kunze, Cymbella gastroides Kuetz.; in surface tow. Synedra sp. (131); once in deep tow. Synedra sp. (120), Cystopleura sp.; surface and deep tow. Navicula viridis (Nitzsch.) Kuetz; on Utricularia vulgaris. Navicula sp. (102), Navicula sp. (130); once in deep tow. Pleurosigma sp.; occasionally in both surface and deep tow.

1 For the sake of uniformity the nomenclature of DeToni in the Sylloge Algarum has been adopted throughout.

DESMIDIEAE.

Cosmarium intermedium Delp.; seen once in surface tow. (Bory) Menegh., C. contractum Kirch., C. tetraophthalmu Breb.; in the swamp. C. margaritiferum (Turpin) Disphinctium connatum (Breb.) De Bary.; in masses of Closterium moniliferum (Bory) Ehrb.; from old logs in the ehrenbergii Menegh., Cl. dianæ Ehrb., Cl. rostratum Ehrb.; i Vaucheria. Staurastrum arctiscon (Ehrb.) Lund, St. dejectur brevispina Breb., St. aspinosum Wolle; in surface tow. St. gr St. muticum Breb., St. furcigerum Breb., Euastrum elegans I midium swartzii Ag., Micrasterias rotata (Grev.) Ralfs, melitensis (Ehrb.) Ralfs, Pleurotaenium trabecula (Ehrb.) masses of Vaucheria.

Utricularia vulgaris abounds in quiet water and becomes place for many minute forms. The following algæ were identi L. N. Johnson from washings of Utricularia vulgaris.

PROTOCOCCACEAE.

Sorastrum spinulosum Naeg.
Pediastrum duplex Mayen.
Scenedesmus bijugatus (Turp.) Kuetz.
Pediastrum boryanum (Turpin) Menegh.
Scenedesmus cordatus Corda.
Nephrocytium agardhianum
Coelastrum microporum Nae
Ophiocytium cochleare (Eich
Tetraëdron minimun (A. Br.)

DESMIDIEAE.

Closterium rostratum Ehrb.
Cl. ehrenbergii Menegh.
Cl. gracile Breb.
Cl. dianae Ehrb.
Cl. moniliferum (Bory) Ehrb.
Cl. juncidum Ralfs.
Cl. venus Kuetz.
Cl. acerosum (Schrank) Ehrb.
Cl. leibleinii Kuetz.
Cl. lineatum Kuetz.
Euastrum elegans Kuetz.
E. binale (Turp.) Ralfs, var. insulare Wittr.
E. binale (Turp.) Ralfs, var. simplex (Wolle) Hansg.
E. verrucosum Ehrb.
Gonatozygon ralfsii De Bary.
Micrasterias rotata (Grev.) Ralfs.
Mic. truncata (Corda) Breb.
Mic. crux-melitensis (Ehrb.) Ralfs.
Mic. fimbriata. Ralfs.
Staurastrum furcigerum Breb.
St. arctiscon (Ehrb.) Lund.
St. polymorphum Breb.
St. gracile Ralfs.
St. teliferum Ralfs.
St. dejectum Breb.
St. avicula Breb.
St. aspinosum Wolle.
St. incisum Wolle, (rough var.).
Onychonema leve Nord., var. n Nord.
Hyalotheca dissiliens. (Smit
Cosmarium broomei Thwaite
C. portianum Arch.
C. contractum Kirch.
C. ornatum Ralfs.
C. botrytis (Bory) Mengh.
C. nitidulum De Not.
C. granatum Breb.
C. subcrenatum Hautzch.
C. margaritiferum (Turp.) M
C. impressulum Elv.
C. sulcatum Nord.
C. schliephacheanum Grun.
C. meneghinii Breb.
C. latium Breb.
Penium margaritaceum (Ehr
Desmidium swartzii Ag.
D. aptogonium Breb.
D. baileyi (Ralfs) De Bary.
Sphaerozosma wallichii Jacol
Pleurotaenium trabecula (Eh
St. dickiei Ralfs.
St. alternans Breb.
St. muticum Breb.
St. crenulatum Naeg.
St. margaritaceum (Ehrb.) M
St. echinatum Breb.
Disphinctium connatum (Br

Two conditions to which water plants must accommodate themselves, are the mechanical effects of the waves and currents and the small amount of light. The few observations made on this point tend to confirm the results of H. Schenck ('86), obtained by a study of the lakes of Europe. He divides the water plants into three classes—the typical hydrophytes; the submersed plants that can, under certain conditions, live as land plants; the more or less amphibious. He finds that they present the following characteristics:

1. The leaves are divided, thin, and have few mechanical elements. This enables them to withstand the movement of the water and permits easy access of the diffuse light.
2. The stem is usually long, thin and flexible.
3. The roots are reduced and serve more for attachment than as organs of absorption.
4. Vegetation is active, the stem grows rapidly at the apex while it dies away at the base.
5. Water plants vary in the form of the leaves and the length of the internodes, according as they grow in rapid, standing, or shallow water.

In Lake St. Clair, the plants growing on the edge of the lake, in water from 20–40 cm. deep, are nearly all stout, leafy plants, Sagittaria, Pontederia cordata, Sparganium and the like. In deeper water, one to two meters deep, we find Scirpus pungens and S. lacustris. These plants are slender and not burdened with a weight of leaves, present a small surface to the action of the water and are flexible. In water 3–7 meters deep, the second condition, the feebleness of the light, must be met as well as the first. The plants of this zone, the Potamogetonetum, are buoyed up by the water in which they are wholly or mostly immersed, and their slender stems and linear or lanceolate leaves enable them to accommodate themselves to its movements. Not only is the mechanical tissue reduced to a small amount, but the leaves are mostly thin and narrow, thus presenting a relatively large surface to the light, but a small resistance to the action of the water. In many Potamogetons the lower leaves die, while the stem grows rapidly and the green leaves are borne near the upper end. Those plants, as Characeae and Naias, that grow on the bottom, have many small leaves or finely divided ones.

SUMMARY.

1. The flora of Lake St. Clair is arranged in more or less well marked zones limited by the depth of the water, and having certain plants characteristic of each zone.
2. The shallow water and the gradual slope of the bottom give rise to a somewhat mixed flora.
3. The Characetum covers the bottom throughout that part of the lake studied. It is probable that this is true for most of the lake.
4. The distribution of the plants is dependent primarily upon the depth of the water.
5. The distribution of the Characeae is dependent also upon the character of the bottom, a sandy bottom being unfavorable and a clay or alluvial one favorable to their growth.
6. The structure of the submersed plants is such as to enable them to meet the two conditions present in the deeper water. These conditions

are the mechanical effects of the waves and currents and the feeble light.

The thanks of the writer are due to Mr. C. F. Wheeler, of Michigan Agricultural college, for determining the Potamogetons, and the more difficult Cyperaceae; to Dr. T. F. Allen for identifying the Characeae; and to Mr. L. N. Johnson for the identification of some algæ and help in identifying others.

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April 3, 1894.

NOTE.

From material brought to the writer from stations XVIII and XIX the following species were identified.

Station XVIII. Elodea canadensis Michx., Potamogeton sp. P. perfoliatus L., P. natans L., Naias flexilis L., and Nitella sp.

Station XIX. Valisneria spiralis L., Naias flexilis L., Potamogeton sp. and Nitella sp.

In November, 1893, the writer collected Zannichellia palustris L., in the Detroit River at Belle Isle.

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EXPLANATION OF THE MAP.

The different zones are indicated by conventional signs; thes drawn only where the zone was actually observed. Further would doubtless have extended these areas. The sign for the F netum has been used in two places in the lake to indicate the a great quantity of Potamogetons. The surface covered by t the Characetum represents the area over which this was actual be present. It is not to be understood, however, that any shar actually exists; further dredging would doubtless have extende perhaps over the entire lake. A larger number of the sign drawn around those stations at which Characeae were found abundance, as in Anchor Bay which was studied more carefull other parts of the lake.

The stations are shown by a cross within a circle. The the stations are in Roman numerals, and the depth of each feet) in Arabic numerals.